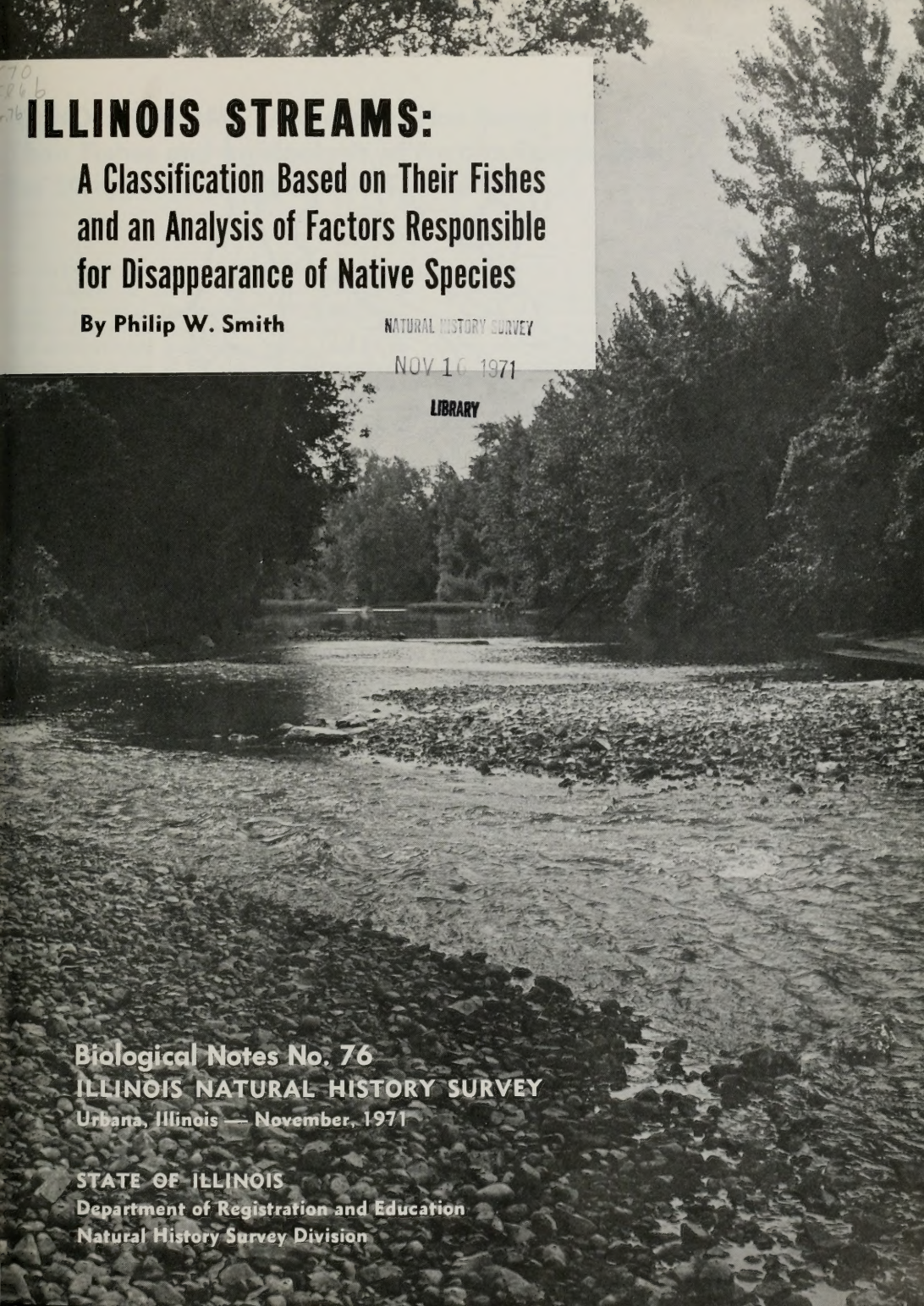
ILLINOIS STREAMS:

A Classification Based on Their Fishes and an Analysis of Factors Responsible for Disappearance of Native Species

By Philip W. Smith



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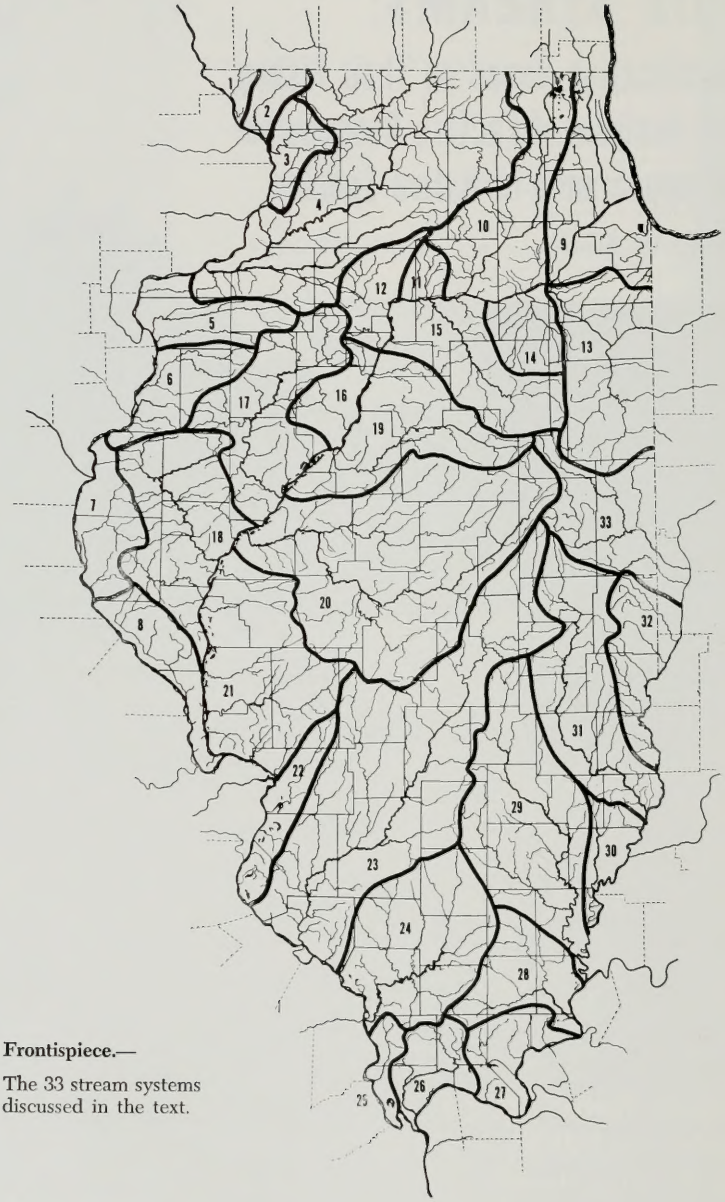

Frontispiece.—

The 33 stream systems discussed in the text.

COVER PHOTO: One of Illinois' finest streams, the Middle Fork of the Vermilion River near Collison, Vermilion County. Photo by Lee Trail.

ILLINOIS STREAMS: A Classification Based on Their Fishes and an Analysis of Factors Responsible for Disappearance of Native Species

Philip W. Smith

ILLINOIS HAS MANY different drainage systems. It is bounded on the west, south, and southeast by great rivers and on the northeast by Lake Michigan. Within its borders it has many creeks, rivers, ponds, and artificial lakes, plus a few glacial lakes in the northeastern corner of the state. Thus it is not surprising that almost 200 species of fishes have been recorded in the state. The great number of streams and variety of stream habitats are primarily responsible for the richness of the Illinois fauna.

As a group, fishes are tolerant and adaptable organisms that can survive considerable habitat abuse, but the ecological tolerances of the many different species vary tremendously. The presence of fish indicates little about the condition of a stream, but a knowledge of the assemblage of species and their numerical relationships provides the ichthyologist with an excellent biological picture of the water course and its well being. When such information is available over a long period of time, fishes can be one of the most sensitive indicators of the quality of the aquatic environment.

From time to time for more than a hundred years, ichthyologists at the Illinois Natural History Survey and other agencies have conducted censuses of Illinois fishes so that, in a sense, changes in the aquatic environment have been monitored all this time. A particularly thorough collecting program spanned the period from 1876 to 1905 and culminated in publication of the classic "Fishes of Illinois" (Forbes & Richardson 1908). The collecting stations are shown in Fig. 1. Another program, begun in 1950 and recently completed, was even more thorough, thanks to modern transportation facilities. The collecting stations are shown in Fig. 2. A wealth of information on changes in fish populations and aquatic habitats in Illinois has been assembled by comparing distributional patterns and census data from the two surveys, and this information is available to interested agencies.

Analysis of these data has made it possible to assign virtually all of the streams in the state ratings of excellent, good, fair, or poor. The ratings are based on the species composition of the hundreds of collections available. It has also been possible to detect long-term changes, and to identify factors that are responsible for each stream's deterioration and each species' change of status.

Owen F. Glissendorf, Technical Editor of the Survey, edited the manuscript. Lawrence M. Page aided in the analysis of data and critically read several preliminary drafts of the manuscript. He and R. Weldon Larimore provided counsel in many areas. Douglas W. Schemske compiled the counts of species known from each drainage system by consulting species distribution maps. Since 1962, Alvin C. Lopinot and his staff in the Division of Fisheries of the Illinois Department of Conservation have deposited in the Survey collection hundreds of fish collections made throughout the state. I have made free use of information assembled in the series "Surface Water Resources" for Illinois counties issued by the Division of Fisheries and recommend these publications to anyone interested in more specific detail about his own county.

CLASSIFICATION AND DESCRIPTION OF STREAMS

The following annotated list of stream systems rates each stream on the basis of fishes presently known to occur in it and its potential for harboring others. A rating of excellent signifies that the expected species are still present in a numerical relationship to each other that indicates little modification of the stream from its original condition. Good, fair, and poor are self-explanatory. Consideration has been given to the varying adequacy of sampling different stream systems. Unusual species and habitats, if present, are noted, and sources of problems in the stream, if they can be identified, are indicated.

The order of treatment is roughly north to south. Stream systems are numbered and can easily be located on the accompanying map (Frontispiece). Tributaries of the river cited are discussed only if their condition differs from that of the main stream. Nearby small streams that are not tributaries are sometimes included because of their proximity and similarity. For example, Menominee, Smallpox, and Sinsinawa creeks are not tributaries of the Galena River, but they are close to the Galena River, and it is convenient to treat the four streams as one unit. The Mississippi, Ohio, Wabash, and Illinois rivers are not included in the annotated list, but their species of fishes are included in the counts for the stream systems if records are available for sites near mouths of the streams.

This paper is published by authority of the State of Illinois, IRS Ch. 127, Par. 58.12. It is a contribution from the Section of Faunistic Surveys and Insect Identification of the Illinois Natural History Survey. Dr. Smith is a Taxonomist and Head of the Section of Faunistic Surveys and Insect Identification.

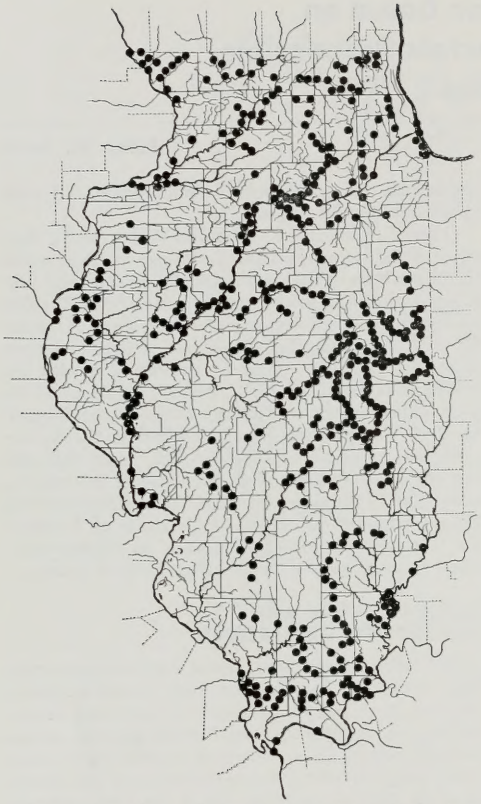

Fig. 1.—Locations of collections of fishes made from 1876 to 1905.

Fig. 2.—Locations of collections of fishes made from 1950 to 1971.

The common names of fishes used in this article are those recommended in American Fisheries Society Special Publication No. 6 (Bailey et al. 1970), in which the scientific names can also be found.

1. *Galena River system* (including Menominee, Sinsinawa, and Smallpox creeks).—Rating good. Species present, 58. Unusual species: longnose dace. Unusual habitats are the gravel-rubble riffles and marginal aquatic vegetation. Barnyard pollution is a minor problem.

2. *Apple River system.*—Rating good to excellent (in upper reaches). Species present, 62. Unusual species: Ozark minnow. Unusual habitats are gravel riffles and clear pools. Some barnyard pollution is present and siltation is a problem in lower reaches, but in general Apple River and its tributaries are exceptionally clean streams.

3. *Plum River system* (including Johnson, Rush, and Otter creeks).—Rating fair. Species present, 53. Unusual species: brassy minnow. Unusual habitats are gravel riffles. Barnyard pollution and siltation are the principal problems.

4. *Rock-Green River system* (including Meredosia Ditch).—Except where it borders or passes through highly urbanized and industrialized areas, the Rock River is rated good and, in some areas, excellent. Species present, 98. The Pecatonica and Green rivers are only fair because of siltation and agricultural pollution. Such tributaries as the Kishwaukee, Leaf, and Kyte rivers and Elkhorn, Pine, Grove, and Piscasaw creeks are good to excellent; other tributaries are fair to good. Unusual species: lake sturgeon, gravel chub, Ozark minnow, brook stickleback, and brassy minnow. Unusual habitats are the rocky and gravelly raceways in some of the rivers, and the small brooks with aquatic vegetation. De-

spite the dams on the Rock River and the urbanization along its banks, the system has not been affected as severely as many other drainages in the state.

5. *Edwards River system* (including Copperas and Pope creeks).—Rating poor to fair. Species present, 52. Habitats are limited, and many of the streams are sand choked and rather sterile. Problems are dredging, agricultural pollution, siltation, and the lack of habitat diversity.

6. *Henderson Creek system* (including Ellison and Honey creeks).—Rating poor to fair. Species present, 57. Most of the streams contain excessive amounts of silt in their headwaters and sand in lower stretches. Problems are siltation, agricultural pollution, and lack of habitat diversity.

7. *Bear Creek system* (including several small, direct tributaries of the Mississippi River).—Rating poor to fair. Species present, 54. Sand, gravel, and rocky riffles and pools are present, but species diversity is low. Problems are desiccation during drought periods and rather severe agricultural pollution.

8. *The Sny-Bay Creek system* (including several small, direct tributaries of the Mississippi River).—Rating poor to fair. Species present, 76. Many habitats are available, and Bay Creek appears to be an outstanding stream with water of high quality. Problems are desiccation during drought periods and agricultural pollution, but these factors cannot account for the low species diversity in the system.

9. *The Des Plaines River system* (including DuPage River, Salt Creek, and other direct tributaries and canals of the Illinois River).—Rating poor. Species present, 63. Problems are domestic and industrial pollution and extensive modification of streams and habitats. It is remarkable that so many streams still contain fish, although some support only goldfish, goldfish-carp hybrids, and green sunfish. Prairie and Jackson creeks have good species diversity, but Hickory Creek is the outstanding stream in the system and contains populations of such unusual species as the northern hogsucker, rosyface shiner, and slender madtom.

10. *Fox River system* (including glacial lakes of Lake and McHenry counties and Aux Sable Creek).—Rating good to excellent. Species present, 102. Unusual habitats are the clear well-vegetated natural lakes, clear gravel-bottomed creeks, and spring-fed streams. Unusual species: blackchin shiner, banded killifish, brown bullhead, Iowa darter, banded darter, and mottled sculpin. The Fox River proper has some domestic and industrial pollution, but most of its tributaries have a variety of habitats and rather high species diversity. Many of the glacial lakes have been ruined by pollution and introduction of sport fishes; others, such as Channel, Grass, Loon, and Cedar lakes, contain a rich variety of native species. Some of the species in this system do not occur anywhere else in the state.

11. *Little Vermilion (of the north) system* (including several nearby direct tributaries of the Illinois River).—Rating fair. Species present, 52. Unusual habitats include clear, gravelly streams. Unusual species: mottled sculpin. The species diversity is rather low, despite the availability of relatively unaltered habitats.

12. *Big Bureau Creek* (including the Illinois and Mississippi Canal and Senachwine Creek).—Rating good to excellent. Species present, 74. Unusual habitats in the area are the fast, sandy and gravelly riffles and clear pools. Some of the streams are sand choked, and the canal is badly silted. Big Bureau Creek and its larger tributaries are relatively unaltered, and agricultural pollution has not had an appreciable effect on the species diversity.

13. *Kankakee-Iroquois River system* (including marginal sloughs and drainage ditches in marshes and sand areas).—Rating excellent. Species present, 72. Unusual habitats are swamps, marshes, clear well-vegetated streams, gravel-rubble riffles, and sand-bottomed pools. Unusual species: ironcolor shiner, weed shiner, blacknose shiner, lake chubsucker, starhead topminnow, northern longear sunfish, and least darter. The Kankakee River and most of its tributaries have excellent species diversity. The Iroquois River is rather sluggish, brushy, and turbid, but some of its tributaries, notably Beaver and Sugar creeks, contain rich assemblages and unusual species.

14. *Mazon Creek system* (including nearby small, direct tributaries of the Illinois River).—Rating good. Species present, 67. Unusual habitats include extensive beds of marginal aquatic vegetation and gravelly riffles and pools. Unusual species: black redhorse, bigeye shiner, and banded darter. Mining and agricultural practices in the area have not appreciably damaged the streams in the system.

15. *Vermilion (of the north) River system* (including Covel Creek and other nearby small, direct tributaries of the Illinois River).—Rating fair. Species present, 80. Unusual habitats are gravelly and sandy riffles and pools, extensive areas of marginal aquatic vegetation, and rocky riffles. Covel Creek has such unusual species as the black redhorse and slender madtom. The Vermilion River has a variety of habitats and should have a richer fish fauna than it has. It has some domestic and agricultural pollution along its length, and its badly silted headwaters are periodically dredged.

16. *Kickapoo Creek* (including Copperas Creek).—Rating good. Species present, 76. Unusual habitats are the clear, gravelly raceways and sand-gravel riffles. Unusual species: blacknose dace, redbelly dace, hornyhead chub.

17. *Spoon River system* (including nearby direct tributaries of the Illinois River).—Rating fair. Species present, 87. In view of the size of the watershed and number of habitats available, the species diversity

should be greater than our collections indicate. Problems are excessive siltation, agricultural pollution, and desiccation of small streams during drought periods.

18. *La Moine River system* (including McKee, Sugar, Crooked, and Bay creeks).—Rating fair. Species present, 78. Problems are siltation, severe agricultural pollution, and desiccation of small streams during drought periods. A few small streams in the area are spring fed and have clear, gravelly riffles.

19. *Mackinaw River system* (including nearby small, direct tributaries of the Illinois River).—Rating good to excellent. Species present, 100. Unusual habitats are sandy and gravelly riffles and pools, and extensive areas with marginal aquatic vegetation. Unusual species: rosyface shiner, silver redhorse, and freckled madtom. Problems are siltation, dredging, and agricultural pollution. Many habitats are present, and species diversity in the Mackinaw River proper is quite high.

20. *Sangamon River system.*—Rating variable. Species present, 94. Unusual habitats are sand-bottomed pools, submerged aquatic vegetation, gravelly riffles, and some deep pools. Unusual species: highfin carpsucker, silver redhorse, ironcolor shiner, spotted sunfish, and banded darter. Problems are siltation; the Lake Decatur dam; industrial, domestic, and agricultural pollution; and dredging. Because of the size of the basin, many different habitats are available and there is a high diversity of species. Salt Creek and its tributaries are less altered than the Sangamon River proper, although both branches have lost some of the species they once had. The headwaters of the Sangamon, Kickapoo Creek, and some small tributaries near the mouth of the Sangamon support particularly rich assemblages of fishes and are rated good; other areas are rated fair.

21. *Indian-Sandy-Apple-Macoupin-Otter creeks* (including other small, direct tributaries of the lower Illinois and Mississippi rivers).—Rating variable. Species present, 87. Unusual habitats include some cold springs and sand-bottomed pools. Unusual species: hornyhead chub, bigeye shiner, redbelly dace, and banded sculpin. Problems are siltation, desiccation during droughts, and agricultural pollution. Otter and Mill creeks have good species diversity; the other streams in the area are rated poor.

22. *Wood River-Cahokia Creek* (including other small tributaries of the Mississippi River in Madison, St. Clair, and Monroe counties).—Rating poor. Species present, 64. Problems are extensive industrial pollution, siltation, and desiccation of small streams during drought periods. The streams in the area lack variety in aquatic habitats and would not have great species diversity even if they were not polluted and otherwise altered.

23. *Kaskaskia-Marys River system.*—Rating variable. Species present, 104. Because of the size of the basin and large variety of habitats, an exceptionally large number of species occurs in this system. Unusual habitats include swamp, sand-gravel riffles and pools, and deep pools. Unusual species: blue sucker, freckled madtom, slender madtom, bigeye shiner, sauger, and river darter. The headwaters of the Kaskaskia are periodically dredged, and the upper section receives much agricultural pollution and some industrial pollution from a manufacturing plant near Tuscola. The middle section of the river receives mine wastes and oil-field pollution. The lower section has been channelized for barge traffic. Many of the tributaries are low-gradient, brushy sloughs that have a limited number of habitats. Such tributaries as Shoal Creek, Crooked Creek, and Silver Creek are swampy with usually turbid water. Until recently the least disturbed part of the basin was the Kaskaskia River and its tributaries in Moultrie, Shelby, and Fayette counties, but the recent creation of Lake Shelbyville destroyed most of the habitats upstream from Shelbyville. Although there is a long list of species recorded from the Kaskaskia system, many species will probably disappear soon. The Marys River would have very poor species diversity were it not for several large-river species that ascend the Marys from the Mississippi River.

24. *Big Muddy River system.*—Rating good in lower reaches, very poor upstream from Murphysboro. Species present, 88. The marginal swamps of the lower course are rich in species. Until the recent creation of Lake Kinkaid, Kinkaid Creek was the outstanding tributary of the Big Muddy. Other tributaries such as Beaucoup Creek, Little Muddy River, and Crab Orchard Creek are low-gradient, brushy streams with little habitat variety, and Crab Orchard Lake has destroyed many of the smaller streams in the system. Most of the basin suffers from siltation, desiccation during drought periods, and oil-field and other industrial pollution. The low quality water supports only the most ecologically tolerant and tenacious species of fishes in the middle and upper parts of the basin.

25. *Clear Creek-Horseshoe Lake system.*—Rating excellent. Species present, 99. Unusual habitats include the nearly unique Pine Hills swamp, luxuriant beds of aquatic vegetation, many cold springs, clear gravelly tributaries, and a large-river habitat near the mouth of Clear Creek. Horseshoe Lake is a typical cypress-lined oxbow with good populations of swamp species. Unusual species in the system: spring cavefish, spotted gar, starhead topminnow, banded pygmy sunfish, bantam sunfish, flier, blacktail shiner, central mudminnow, and river darter. Although much of Clear Creek appears to be a lowland stream, it and its clear, gravelly tributaries have an incredible list of species, some of which do not occur anywhere else in the state.

26. *Cache River system.*—Rating good. Species present, 81. Although the lower and middle stretches

of the Cache River consist of cypress swamp and mud-bottomed sloughs, many of the headwater streams are clear and gravelly, and some are spring fed. Unusual species: flier, blackspotted topminnow, cypress darter, spottail darter, and stripetail darter. Problems are desiccation during drought periods and siltation.

27. *Massac-Bay-Lusk-Big Grand Pierre-Big Creek system* (including many lesser direct tributaries of the Ohio River and some marginal lakes and swamps).—Rating excellent to good. Species present, 79. The outstanding stream in the system is Big Creek, closely followed by Lusk Creek. Unusual habitats are clear, rock-bottomed pools, gravelly riffles, and cold springs. Unusual species: black redhorse, rock bass, smallmouth bass, cypress darter, spottail darter, stripetail darter, and banded sculpin. The smaller streams in the area are rated fair, and those not fed by springs are subject to desiccation during drought periods and to some agricultural pollution. The lowland lakes and swamps have good populations of lacustrine species such as the pugnose minnow.

28. *Saline River system.*—Rating poor. Species present, 57. Problems are stripmine wastes, siltation, oil-field pollution, drainage of natural lakes and ponds, desiccation during drought periods, and a paucity of aquatic habitats. Some parts of the Saline River are devoid of fish because of the discharges of acid from coal mines, and its tributaries have rather low species diversity. Several species have been extirpated.

29. *Little Wabash River system.*—Rating poor in lower reaches but very good in upper part of the system. Species present, 78. Problems are oil-field pollution, siltation, and desiccation during drought periods. Tributaries such as the Skillet Fork, Elm River, and Fox River are low-gradient, brushy streams with oil pollution and very low species diversity. The Little Wabash River between Louisville and Neoga has alternating pools and sand or sand-gravel riffles and high species diversity. Unusual species: spotted bass, bigeye shiner, greenside darter, and dusky darter. Tributaries in the upper portion of the basin are shallow, sandy streams with fair species variety; the headwaters of the Little Wabash above Lake Mattoon are badly silted.

30. *Bonpas Creek system* (including some small, direct tributaries of the Wabash River).—Rating fair. Species present, 71. There is a limited number of habitats available in this small watershed, and oil-field pollution, drainage of natural lakes and ponds, and siltation have taken their toll of native species. Unusual species in the system are the pugnose minnow and spotted sucker; the nearby Wabash River has an extremely rich variety of species.

31. *Embarras River system.*—Rating variable. Species present, 92. The lowermost section of the Embarras has oil-field pollution and has been partly rechanneled, and the headwaters above Lake Charleston are badly silted. A major tributary, the North Fork, has severe oil-field pollution and siltation. These three areas must be rated fair to poor, but the major part of the Embarras River proper and especially the stretch from Charleston to Newton has an excellent variety of habitats and extremely rich species diversity. Unusual species: harlequin darter, dusky darter, eastern sand darter, spotted bass, mountain madtom, and greenside darter. The harlequin darter does not occur anywhere else in the state. The middle section of the Embarras is one of the outstanding Illinois streams.

32. *Direct tributaries of the Wabash River in Crawford, Clark, and Edgar counties.*—Rating good. Species present, 82. The outstanding streams in the system are Mill Creek, Big Creek, and Brouilletts Creek, all of which contain sandy and gravelly pools and riffles and water of high quality. Unusual species: blacknose dace, redbelly dace, greenside darter, and bigeye shiner. Some oil-field pollution exists in the watersheds, but the streams suffer most from desiccation during drought periods.

33. *Little Vermilion-Vermilion River system.*—Rating variable. Species present, 86. The Little Vermilion has been in part rechanneled and dredged and is subject to desiccation during low-water periods. The Vermilion is badly polluted by domestic sewage several miles downstream from Danville but recovers before it leaves the state. The North Fork is badly silted above Lake Vermilion and somewhat polluted below the lake. The West Branch is devoid of fish most of the year because of domestic sewage from Champaign-Urbana, and the East Branch receives some pollution from Rantoul and Chanute Air Force Base. The Salt Fork between Homer and Danville consists of clear pools, wide sand and gravel bars, and rubble-gravel riffles and has quite high species diversity. The outstanding stream in the system, and one of the finest in Illinois, is the Middle Fork, which in addition to the habitats listed for the Salt Fork has some boulder riffles and exposures of bedrock. Unusual species: bluebreast darter, river redhorse, dusky darter, eastern sand darter, mimic shiner, and rosyface shiner. The bluebreast darter does not occur anywhere else in the state.

The number of species in a stream system depends on the number of relatively unmodified habitats available. In general, a large drainage system will contain a greater variety of habitats and more species than a small one. For example, the Kaskaskia River system is the largest in Illinois and has the greatest variety of fishes (104 species). However, the relationship is not absolute. Other stream systems with high species diversity are the Fox (102 species), Mackinaw (100 species), Clear Creek (99 species), Rock-Green (98 species), Sangamon (94 species), and Embarras (92 species). The Fox, Mackinaw, and Embarras systems are moderate in size, and Clear Creek has a rather small drainage basin.

Some of the systems with low species diversity are the Edwards (52 species), Little Vermilion (of the north) (52 species), Plum (53 species), Bear Creek (54 species), and Saline (57 species). Most of these streams have rather small watersheds.

LONG-TERM CHANGES IN ILLINOIS FISH POPULATIONS

If freakish discoveries of aquarium escapees and released pets are ignored, the list of species recorded from Illinois waters stands at 193 (13 naturalized and 180 native species).

Four of the 13 non-native species (brown trout, goldfish, carp, and grass carp) are exotic species. Six of them (rainbow trout, brook trout, coho salmon, chinook salmon, American smelt, and white catfish) are native to other parts of this continent and have been deliberately stocked in Illinois waters. Three of them (sea lamprey, alewife, and threadfin shad) are native to other parts of this country and have recently extended their ranges into Illinois.

Of the 180 native species, 8 (silverjaw minnow, bigmouth shiner, red shiner, redfin shiner, fathead minnow, creek chub, mosquitofish, and redear sunfish) have expanded their ranges in Illinois and increased in abundance. The first three cited thrive in small, shallow streams with sand bottoms and moderate current and are quite resilient to dredging, straightening, and other modifications of streams. It has been shown that in Champaign County, streams tend to be wider and shallower than formerly (Larimore & Smith 1963:320), thus increasing the amount of preferred habitat for these mobile and aggressive species. Similar changes have occurred over the entire state.

The redfin shiner, fathead minnow, and creek chub occupy quiet pools of small streams with silt bottoms, and they are rather tolerant of turbid waters. Siltation and other human alteration of watersheds have increased the amount of favorable habitat for these fishes. The mosquitofish and redear sunfish, native to southern Illinois, have been widely transplanted in efforts to control mosquitoes and to provide another species of panfish in many reservoirs. Both are tolerant of some habitat abuse and have strong dispersal powers.

For 104 of the native species little change was revealed in distribution and abundance. This may be attributed to less adequate sampling during the first censusing as reported by Forbes & Richardson (1908) or because the change in status of these species could not be clearly demonstrated for various reasons.

Eight native species have been extirpated in Illinois and 60 other native species show clear-cut evidence of range shrinkage and decimation. Some of the latter group reveal rather minor reductions in range size and abundance; others are so severely decimated as to be endangered, and some of them may have been extirpated in Illinois since our survey was completed.

FACTORS RESPONSIBLE FOR CHANGES IN FISH POPULATIONS

If the present ranges and former distributions of the native fish species in Illinois are carefully examined, it is possible in most cases to identify the factor chiefly responsible for the extirpation or decimation of each species. A tally of the species affected by each identified factor permits an objective assessment of the environmental changes responsible and brings each factor into perspective.

Silt

Excessive siltation ranks first and is implicated as the principal cause for the extirpation of 2 native species and the decimation of 14 others. Its effects include loss of water clarity and subsequent disappearance of aquatic vegetation, and the deposition of silt over substrates that were once bedrock, rubble, gravel, or sand. Feeding and spawning sites, as well as the usual habitats for such fishes, have been reduced over much of the state.

The crystal darter, described from a small tributary of the Mississippi River in Hancock County (Jordan 1878:38), once occurred also in the Rock River, Little Wabash River, and Mississippi River in Jo Daviess County (Forbes & Richardson 1908:301), but it has not been found in the state since 1900. The gilt darter was collected in the Rock River as early as 1877 (Forbes & Richardson 1908:289) and found there in 1927 and 1932 (O'Donnell 1935:489), but it has not been taken anywhere in the state since, despite careful searches in recent years.

The bigeye shiner, bigeye chub (Fig. 3), and pugnose minnow (Fig. 4), all of which require clear water, have been decimated primarily because of the disappearance of aquatic vegetation. The mooneye, highfin carpsucker (Fig. 5), rock bass, longear sunfish, and walleye have been adversely affected by increasing water turbidity. The gravel chub (Fig. 6), Ozark minnow, weed shiner (Fig. 7), western sand darter, banded darter (Fig. 8), and slenderhead darter have reduced ranges because they have lost extensive gravel- and sand-substrate habitats to silt.

Excessive siltation has adversely affected fishes over a long period of time and has drastically altered stream habitats over the entire state with the possible exception of high-gradient streams in extreme northwestern Illinois.

Drainage

Drainage of natural lakes, sloughs marginal to large rivers, swamps, and prairie marshes ranks second in importance and is responsible for the shrink-

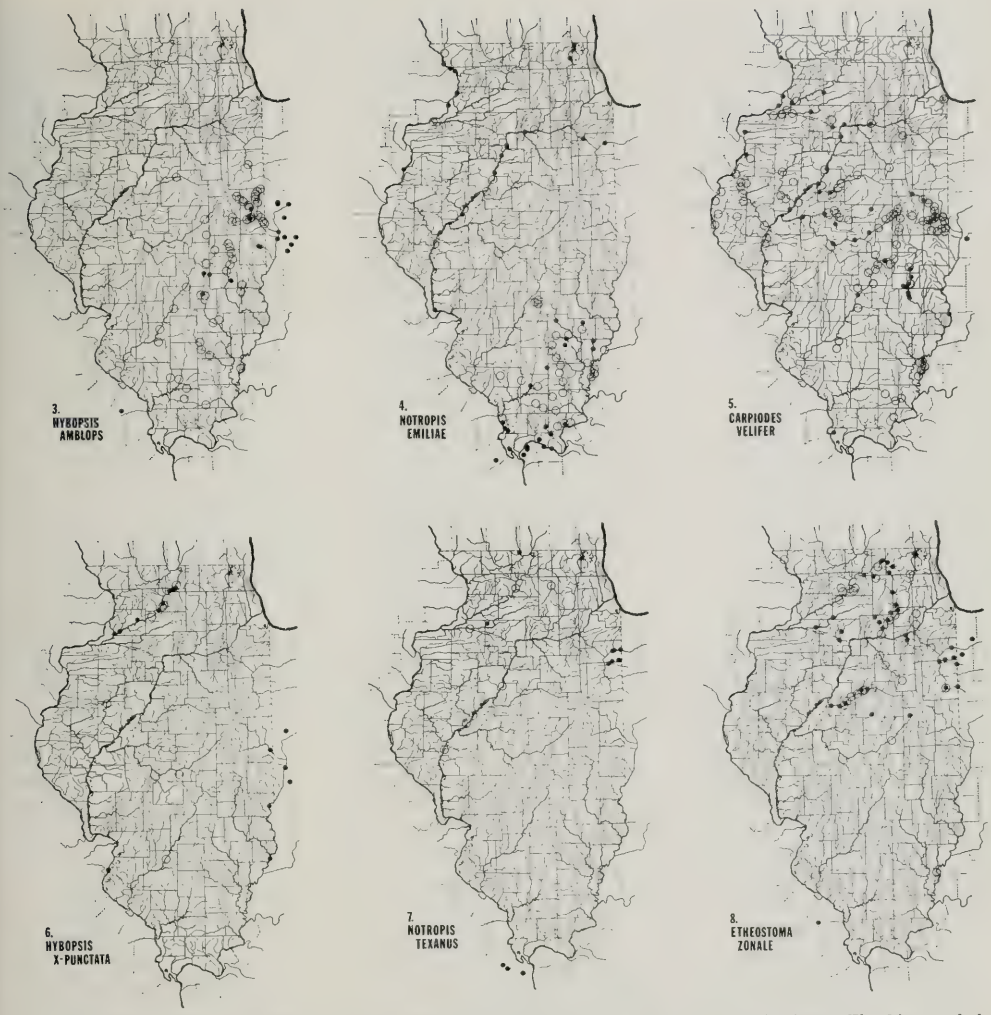

Fig. 3–8.—Some species of fishes decimated because silt has destroyed many of their habitats. The bigeye chub, last collected in Illinois in 1961, may already be extirpated. Circles, before 1905; dots, after 1950.

age in range of 13 native species. The populations of pugnose shiner, blackchin shiner, blacknose shiner (Fig. 9), and banded killifish (Fig. 10) have been reduced to a few glacial lakes in extreme northeastern Illinois as a result of the widespread drainage of natural lakes and marshes in the northern half of the state. The ranges of the bowfin, central mudminnow (Fig. 11), lake chubsucker, brown bullhead (Fig. 12), starhead topminnow (Fig. 13), pygmy sunfish, bantam sunfish, spotted sunfish, and Iowa darter (Fig. 14) have shrunk as a result of the drainage of the floodplain lakes and sloughs marginal to the large rivers.

Strictly lacustrine species such as the pugnose shiner, blackchin shiner, and banded killifish are especially affected, for when the lake is drained the populations of these fishes are eliminated and there is no opportunity for recruitment into newly created impoundments. Semilacustrine species such as the

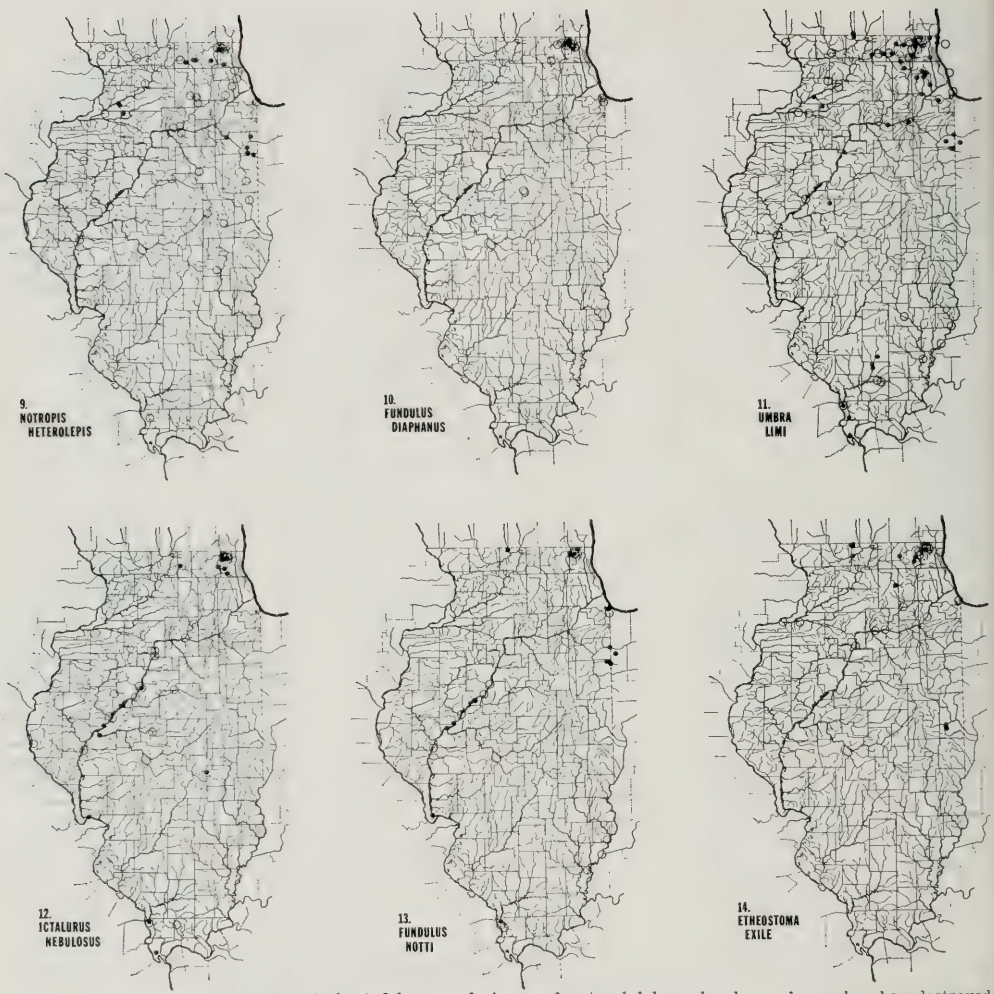

Fig. 9–14.—Some species of fishes decimated because drainage of natural lakes, sloughs, and marshes has destroyed many of their habitats. Circles, before 1905; dots, after 1950.

bowfin, mudminnow, and others, on the other hand, may have nearby populations in stream oxbows or pools that can disperse into new bodies of water. However, new artificial lakes are usually populated by stocked species and minnow-bucket releases.

Drainage has affected fishes for many years and has produced the most dramatic effects by the elimination of bottomland lakes and sloughs marginal to all of the large rivers and the prairie swales throughout the northern half of Illinois.

Desiccation During Drought

Desiccation of stream systems during drought periods ranks third in importance and is responsible for the range shrinkage of 12 species. In recent decades the water table has fluctuated more widely than it did before 1930. During severe late summer and fall drought, streams that were once permanently flowing now dry up, seeps and springs cease to flow, and some relatively large rivers temporarily become medium-sized or small streams.

The effects of desiccation have been particularly devastating on headwater and creek species such as the silvery minnow (Fig. 15), hornyhead chub, striped shiner, redbelly dace, blacknose dace, longnose dace, creek chubsucker (Fig. 16), bluntnose darter (Fig. 17), and slough darter. The effects of reduction in size of streams on large-river species are most dramatically seen in range shrinkage of such typical large-river species as the emerald shiner (Fig. 18), bullhead minnow (Fig. 19), and mud darter (Fig. 20). When large-river habitat is no longer available, these fishes move downstream to their proper habitat or perish. Annual droughts require that tributaries be reoccupied each spring when the streams are flowing again and are of sufficient size to provide the proper habitat.

Stream desiccation is a relatively new factor that has had its most devastating effects since 1930. Prior to that year droughts had less effect because the water table was less variable. Desiccation has been

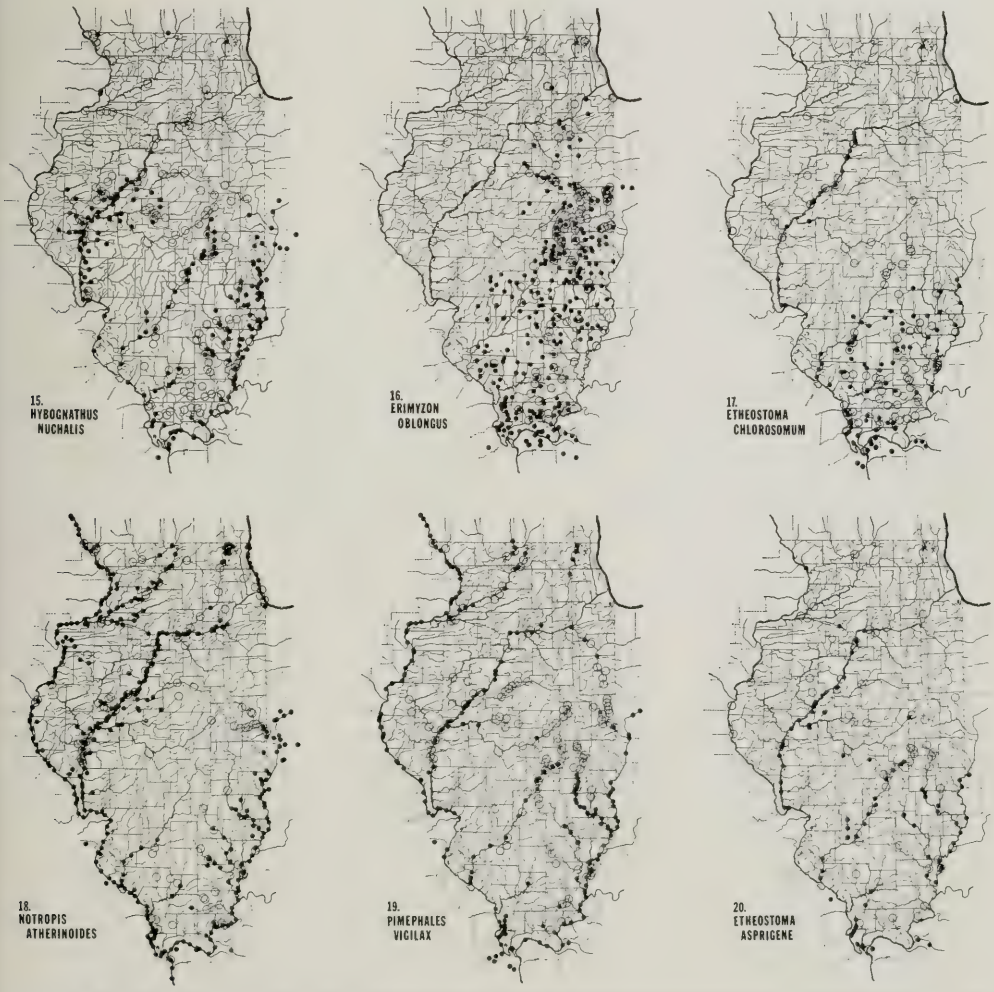

Fig. 15–20.—Some species of fishes decimated because desiccation during drought periods has eliminated many of their habitats. Circles, before 1905; dots, after 1950.

most damaging in southern, western, and central Illinois. During severe droughts, swamps, springs, creeks, and even small rivers have dried up.

Species Interaction

Species interaction following modification of a stream or watershed ranks fourth and is responsible for the extirpation in Illinois of the Ohio lamprey and the rosefin shiner and the decimation of seven other species. Prior to 1917 the Ohio lamprey occurred in the Wabash watershed, but the allied and allopatric chestnut lamprey has since supplanted the Ohio lamprey in all of eastern Illinois and western Indiana (Starrett, Harth, & Smith 1960). The rosefin shiner occurred in extreme southeastern Illinois in the last century but has been supplanted in Illinois and adjacent Kentucky by the more ecologically tolerant and allopatric redfin shiner.

In addition to competition between members of a pair of closely related fishes, there have been interactions unrelated species that resulted in the decimation of several native species. The explosive appearance of the sea lamprey in Lake Michigan in the 1940's was followed by a dramatic decline in populations of the cisco, lake whitefish, round whitefish, lake trout, and burbot. When the ecological balance was upset by sea lamprey predation, the alewife appeared and mushroomed in numbers to become a serious pest in Lake Michigan.

The aggressive and ecologically tolerant red shiner has gradually moved eastward in Illinois (Larimore & Smith 1963) and has displaced the related spotfin shiner (Fig. 21), and steelcolor shiner (Fig. 22) in most parts of central Illinois (Page & Smith 1970). Habitat modification evidently resulted in a breakdown of the reproductive isolating mechanisms in this group of species and permitted the red shiner to hybridize with and eventually replace the other two species.

Such species interactions have been in progress for a long time and throughout the state. The effects on certain native fish by the introduced carp and goldfish are so well known that no comment is required. More recent stockings of the white amur, redear sunfish, mosquitofish, white catfish, and salmon species outside their natural ranges may pose equally serious threats to native fish populations in the future.

Pollution

Pollution other than silt includes industrial, domestic, and agricultural pollutants and ranks fifth. It can be implicated as the cause for the extirpation of two and decimation of five fishes. The greater redhorse occurred in Salt Creek in northeastern Illinois but disappeared sometime after 1901 when the stream became polluted. The cypress minnow occurred in the Little Muddy River as late as 1940 and was eliminated by pollution, presumably from nearby oil fields.

The ranges of the silver chub, river shiner, brindled madtom (Fig. 23), bluebreast darter, and blackside darter (Fig. 24) are less extensive than formerly because of localized pollution in several stream systems in eastern and southern Illinois.

Virtually all of the streams and lakes in Illinois have been affected to some degree by pollution. Among the most dramatic illustrations are streams and lakes in the greater Chicago area because of industrial and domestic pollution, the Big Muddy and lower Little Wabash systems because of oil-field pollutants, the Illinois River because of domestic sewage from Chicago and other cities, most of the Saline system because of coal mine wastes, small

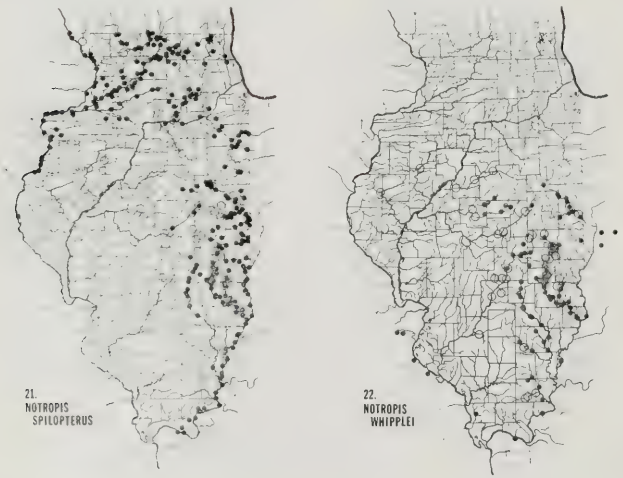

Fig. 21–22.—Two species of fishes decimated because they were unable to compete with the related red shiner after their original habitats had been altered. Circles, before 1905; dots, after 1950.

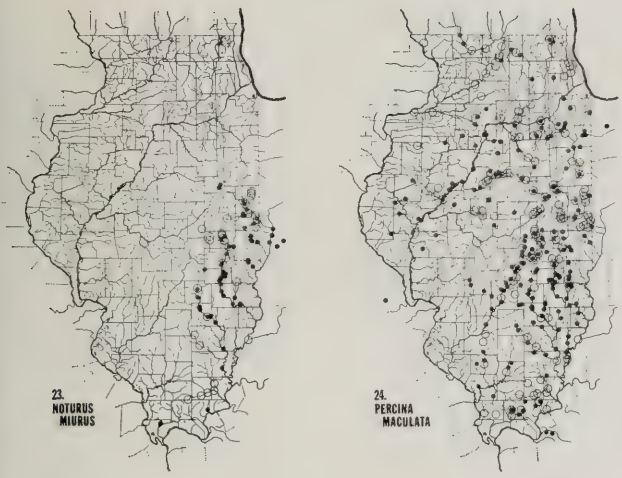

Fig. 23–24.—Two species of fishes decimated because pollution has lowered the water quality of streams that they inhabited. Circles, before 1905; dots, after 1950.

streams in western Illinois because of runoff from hog farms, and the West Branch of the Salt Fork because of sewage effluents from Champaign-Urbana.

Fish kills have occurred repeatedly when toxicants such as anhydrous ammonia and cyanide have been accidentally or deliberately dumped into streams. In most cases the streams are repopulated in 2 or 3 years, but endemic and relict species cannot return once the population has been eliminated.

The revelation that water pollution ranks fifth among the principal causes for extirpation and decimation of native fishes is rather surprising. However, many fishes are remarkably resistant to some degree of pollution as long as the physical habitat remains intact. Also, in many parts of Illinois, pollution has become critically severe only in the last few years, whereas other factors have been operative for a century or more.

Dams and Impoundments

The construction of dams to create mainstream impoundments ranks sixth and is responsible for the decimation of four species of riffle-inhabiting fishes. The flowing stream consists of alternating riffles and pools. Riffles may flow over bedrock, boulders, rubble, gravel, or sand, and each bottom type comprises a distinctive habitat. Pools also may have different habitats, depending on the type of substrate and current. When a stream is impounded, riffles are eliminated and the bottom of the reservoir quickly becomes silt, resulting in only one habitat. The richness of the fish fauna is directly related to the number of different habitats available. Dams also block natural migration and dispersal of fishes.

The greenside darter (Fig. 25), eastern sand darter (Fig. 26), fantail darter, and dusky darter have been decimated in the North Fork (Vermilion drainage) and Embarras River by mainstream impoundments (Smith 1968). The bullhead minnow is now restricted to that part of the Embarras River below the Charleston dam but once occurred farther upstream.

The effects of dams on the fishes of the Mississippi, Illinois, Kaskaskia, and Rock rivers are more difficult to document, but the dams are insurmountable to migratory fishes except when the streams are in flood condition, and many miles of stream that formerly contained several distinctive habitats now have only one.

The several proposed reservoirs in Illinois threaten many native species because they are planned for some of the most valuable waterways left, and many of the unique aquatic habitats in the state will be lost if the streams are dammed.

Temperature

The cutting of marginal trees and other vegetation that afford shade, coupled with a reduced flow of cold springs and low water levels during summer droughts, result in higher water temperatures now than formerly. No data on past stream temperatures are available, but temperature offers the most likely explanation for the disappearance of the northern pike in streams of western Union County, where it occurred prior to 1900 (Forbes & Richardson 1908, atlas of maps).

Outlier populations of such species as the hornyhead chub, blacknose dace, longnose dace, redbelly dace, and hogsucker in Union County have also been eliminated, probably because they cannot survive the summer stream temperatures. However, in other areas of the state their decimation is more likely the result of stream desiccation and siltation.

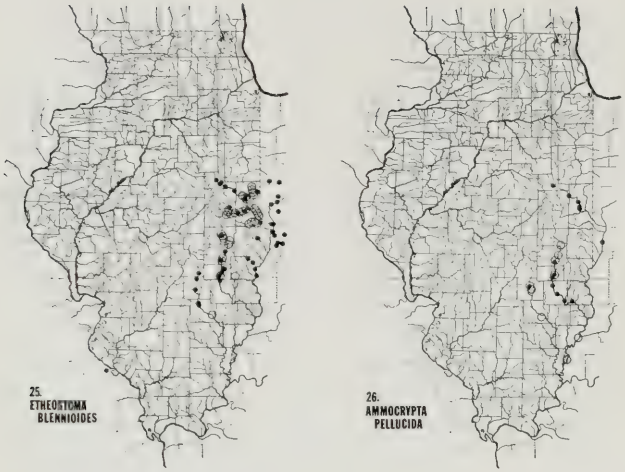

Fig. 25–26.—Two species of fishes decimated because impoundments have destroyed many of their habitats. Circles, before 1905; dots, after 1950.

Unknown Causes

No single factor can be identified as the probable cause for the extirpation in Illinois of the muskellunge, which once occurred in extreme northern Illinois, and the stargazing darter, which once occurred in the lower Wabash River (Smith 1965). The decline of the lake sturgeon, blue sucker, and paddlefish is probably due to a combination of such factors as dams, silt, drainage of marginal lakes, pollution, and overexploitation. The decimation of the orangespotted sunfish, a species rather tolerant of silt and some pollution, is inexplicable.

So-called channel improvement through dredging and stream straightening destroys habitats over extensive stretches of streams, but by itself it cannot be regarded as the principal cause for the decimation of any native fish.

Summary of Factors Discussed

The following tabulation lists the factors primarily responsible for the extirpation of 8, and the decimation of 60, native species of Illinois fishes.

	Number of species extirpated	Number of species decimated
Silt	2	14
Drainage	0	13
Desiccation during drought	0	12
Species interaction	2	7
Pollution	2	5
Dams and impoundments	0	4
Temperature	0	1
Unknown causes	2	4

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